

Engine Removal

3

Introduction

With the skies clear and the sun shining, you're eager to pull that tired player out of the engine compartment, whip through the rebuild, and install it in the same weekend. While this is possible if you're extremely organized, have all the parts and tools you'll need, and have access to a twenty-four hour machine shop, chances are real slim that you'll pull it off.

Realistically, if you have some mechanical aptitude, the parts you need are readily available, and the local machine shop isn't swamped, you can remove, recondition, and install your engine in about a week. This means working two full weekends and about five hours each week night.

Before you even consider removing the engine, you should clean it and the engine compartment thoroughly. A clean engine is easier to work on; allows you to see any broken, cracked, or damaged pieces otherwise obscured under grime; saves you time; and preserves the skin on your knuckles.

Help for this period of spic and span can come in the form of degreasing agents, or just good old soap and water. A degreasing agent can make quick work of removing years worth of dirt, oil, and sludge, and it has the advantage that you can use it in the privacy of your own driveway.

After the engine's clean, run it for half an hour or so to dry it off. Then park the vehicle in the garage or driveway in the position you'll want it to be for the entire rebuilding process.

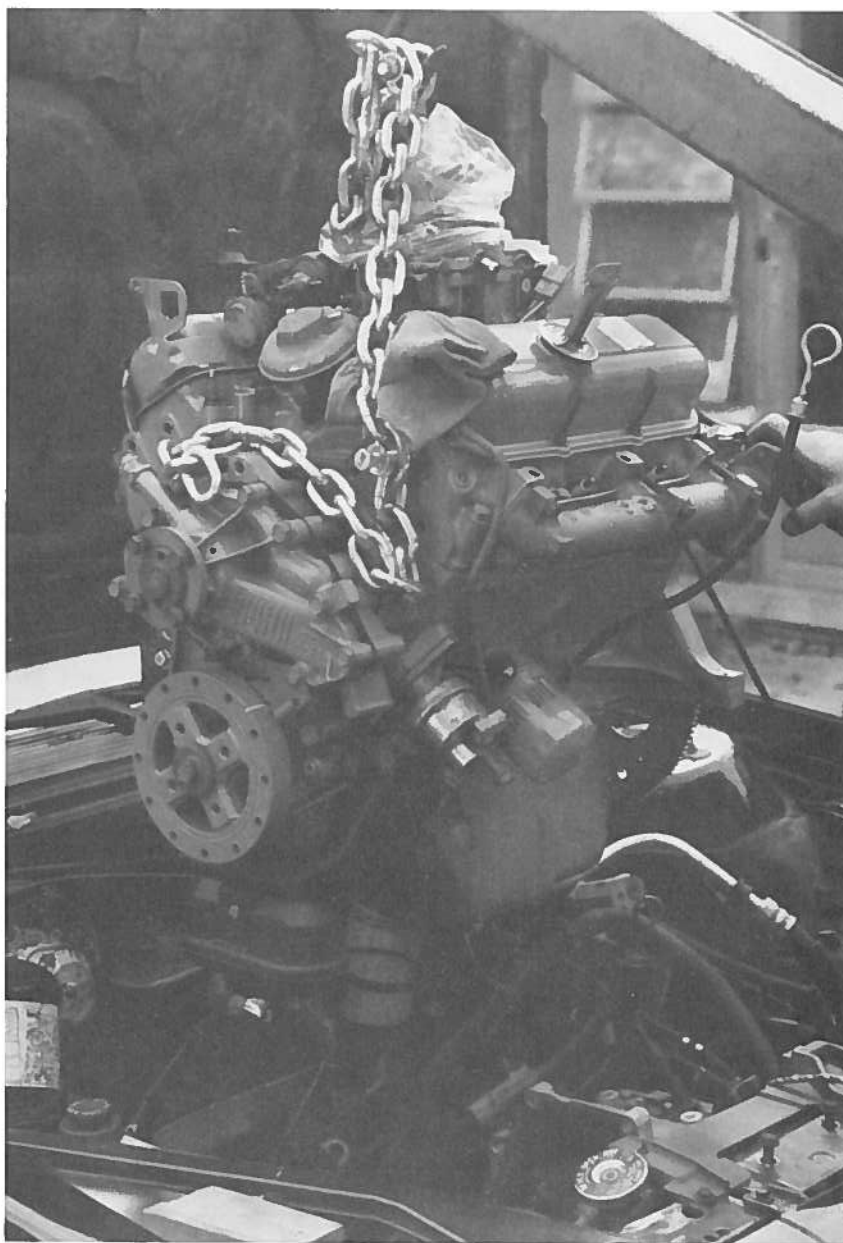
Consider your work area carefully, because rebuilding schedules can slip for a variety of reasons, including a lack of time, other commitments, and time required to ship parts. Furthermore, once you've taken a few major pieces off the engine, the only way you're going to move the vehicle is with your legs or a tow truck. Also, you'll need a hard surface on which to maneuver the engine hoist.

If you choose to turn your driveway or the street in front of your

house into a workshop, be prepared for lost tools, bad weather, and insufficient lighting. There will also be innumerable questions, and perhaps complaints, from your neighbors. The

local boys in blue may take an interest in your project as well.

The best place to do this kind of work is in the privacy of your own garage. You may have to wheel the



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Always disconnect the negative battery cable to prevent damaging the Electronic Control Module (ECM), which is

the "brain" of any modern vehicle. A replacement ECM can run in the hundreds of dollars.

car out to remove and install the engine with a cherry picker, but you'll save yourself a lot of headaches. When you position your car in the garage, remember to leave at least 3ft of working room around its front and sides.

After the car is in the garage, shut off the engine, and let it cool overnight. In the morning, you can

drain the engine oil and coolant. Before doing anything else, disconnect the battery's negative cable. This removes the ground for all of the electrical components and protects the computer.

You also need to consider vehicle working height. It's a good idea to raise the vehicle and support it with jackstands, because if it's too low,

you'll end up stretching as you work, which can be hard on your back. There also won't be enough room underneath to safely and easily loosen and remove components.

If you're not sure where to position the jack or the jackstands, follow the instructions in your owner's manual. Whatever you do, make sure the vehicle is properly supported before you crawl underneath it, and never use cinder blocks for jackstands. When cinder blocks reach their breaking point, they'll just crumble with no advance warning.

Marking Components

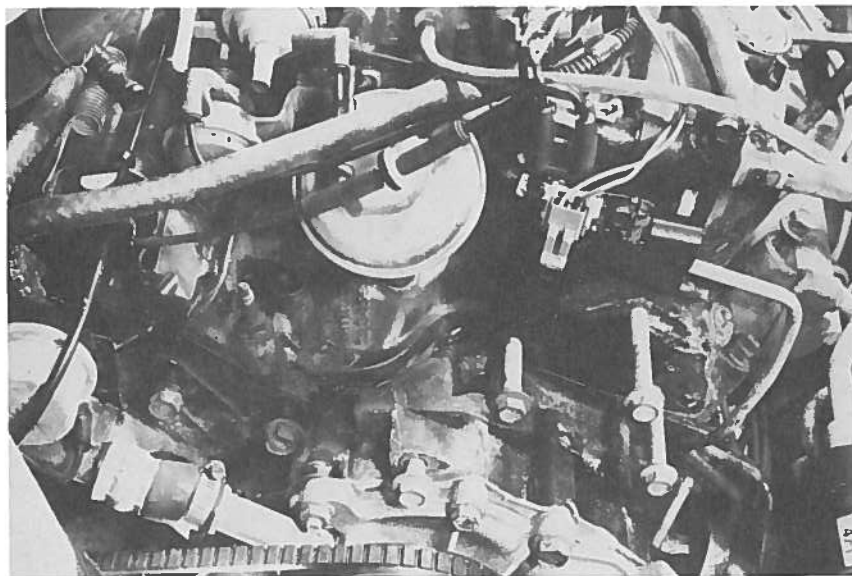
You can save a considerable amount of time and grief when reconnecting all the wiring and hoses if you mark them all before disconnecting them. You may be tempted to ask, "What's so difficult about remembering which wire went where or which vacuum line was connected to what?" The answer is "Nothing—if you have a photographic memory."

Modern engines have a surprisingly large number of vacuum hoses and wires, and each is essential to proper engine operation. If you can't identify these hoses and wires now, you probably won't be able to identify them later—which means that your freshly rebuilt engine won't perform at its optimum, if at all. Use photographs, identification tags, and drawings to identify all the hoses and wiring.

None of these marking systems needs to be fancy. A Polaroid Instamatic camera can provide photos of sufficient detail to use during the assembly process. (Since Polaroids tend to be a bit dark, you'll probably want to add some supplemental lighting such as a clip light or two.) If you are using a 35mm camera, make sure that you bracket your shots. Use color film as well so wire colors are captured.

Take photos of the vacuum hoses at the carburetor, fuel injection system lines, throttle and cruise control cable routing, the wiring where it attaches to each component, and anything else you think you might need. "Extra" photos are cheap insurance against future assembly problems.

Making identification tags for the vacuum hoses and electrical wiring will help fill the information voids that pictures can leave behind. Make the tags from heavy paper or shirt cardboard and use string to at-



Here's just a sampling of what you're up against. If you don't have photos, ID tags, and drawings to help you put

Humpty Dumpty back together, you'll be sorry.

tach each tag to the hose, wire, or component in question. Alternatively, you can buy ready-made tags at an office supply store or use masking or duct tape.

Write all descriptions with a permanent marker so they won't fade. If you don't know the name of a particular component, assign it a number or letter, with a matching number or letter on the component from which it is removed. For added insurance, apply clear tape over the tags to protect them from dirt smudges.

Unlike photos or identification tags, carefully made drawings can show you how various components or brackets are assembled to the engine. Again, this will be quite important around assembly time.

Together, photos, identification tags and drawings can help speed the assembly process, decrease the chances of a driveability problem due to improper assembly, and save your sanity.

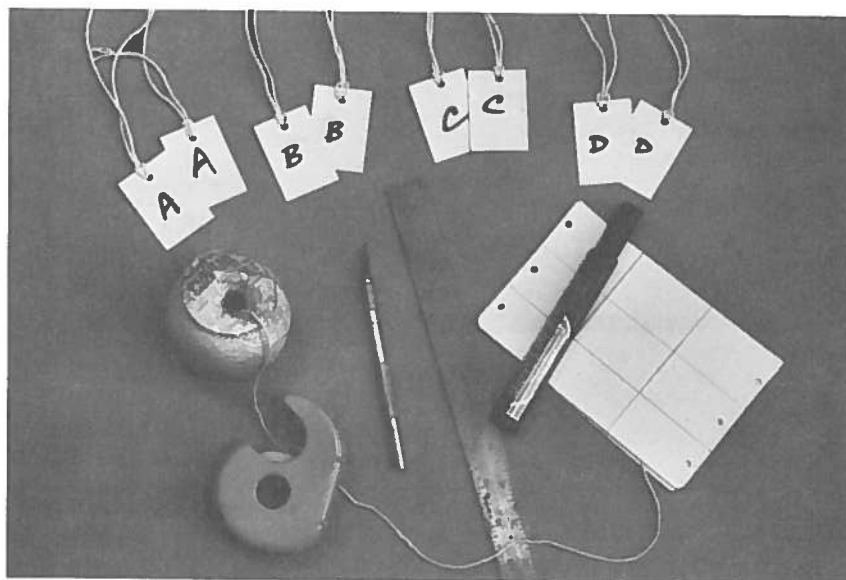
Bag It!

Before beginning any disassembly, you should also plan how you'll keep track of the various nuts, bolts, and screws you'll be removing. Probably the surest method is to keep fasteners with the parts they attach to. This alleviates the need for knowing which grade of fastener went where or whether a bolt is of the proper length. The downside to this method is that you'll have to remove the fasteners when cleaning, reconditioning, or painting the parts, thus inviting the fastener's loss. Even so, it's much easier to keep track of a small number of fasteners than all the fasteners that hold the engine together, and you'll be assured of putting the right bolt with the right level of hardness where it belongs.

The next best method for fastener organization is using zip-top plastic bags. This allows you to keep the fasteners separate from one another while providing a place to identify the contents. Always mark the bag's exterior with a permanent marker; don't make the mistake of identifying the bags by placing slips of paper inside. Many fasteners are covered with oil, which will erase any writing on the paper.

Fluids

Your engine uses two types of fluid: engine oil and coolant. You need to drain both of these fluids *before* re-



You need to tag all of the wiring and hoses to ensure proper assembly later. Shirt cardboard, an X-acto knife, string, and a magic marker are all you need to

make good-quality tags. If you don't know component names, identify them with letters or numbers.

moving the engine components. This prevents cool-ant from getting into the lubrication system and oil from getting everywhere when you remove the oil pan.

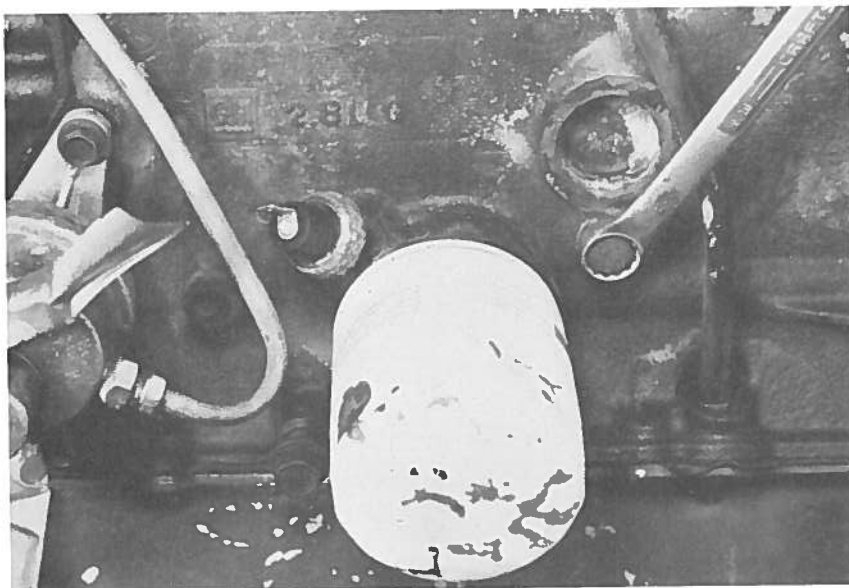
To drain the engine oil, put a drain pan underneath the oil pan drain plug, then remove the plug. Let the oil drain for 20min or so. Draining the coolant from the engine is simple

if your radiator has a petcock: simply slide a drain pan underneath it and screw the petcock in toward the radiator. If you don't have a petcock, remove the lower radiator hose from either the water pump or the radiator, depending on whichever end of the hose is more accessible. If the hose is fitted with factory wire-type clamps and the screws won't loosen, carefully



On vehicles without a radiator petcock, you'll need to remove the lower radiator hose to drain the coolant. It can be dis-

connected at either the radiator or water pump end.



To ensure that the block is drained as much as possible, remove the drain plugs from the block (one each side).

cut them off the hose with a pair of side cutters and discard them; replace them with screw-type band clamps during reassembly. To avoid flooding yourself and the ground with coolant when you remove the hose, crimp it with a pair of locking pliers with long, straight jaws.

When the hose is "shut off," take the tip of a flat-bladed screwdriver and gently work it in between the

hose and nipple to break the seal between them. When you've worked your way around the entire inner diameter of the hose, twist it back and forth. When it rotates on the nipple, you've broken the seal.

Now place a drain pan on the ground underneath the nipple to catch the old coolant. Twist the hose back and forth while slowly pulling it off the nipple. After all the coolant has

drained from the radiator, direct the end of the lower radiator hose into the drain pan and release the locking pliers.

To ensure that most of the coolant is drained from the block, remove the coolant drain plugs on both sides of the block. These plugs have a hex head, just like a normal bolt, and are located near the center of the block, below the exhaust manifolds. A significant amount of coolant will be released, so put a drain pan underneath the plugs before removing them.

Be aware that in some later-model engines, the knock sensor does double duty as a drain plug. This sensor is located on the back or right-hand side of the block just behind and below the core plug—exactly where the drain plug would be if it used one.

Remember to always properly dispose of all drained fluids. Many cities now collect used oil and anti-freeze for recycling, so do your community a favor and take old automotive fluids to the nearest recycling center. Also, be sure to clean up any spilled coolant; its sweet smell and taste will attract animals, and a little nip can kill them.

Radiator

As you prepare for engine removal, it's a good idea to remove the radiator so that it can be cleaned or reconditioned at a radiator shop. This ensures the radiator is up to the task of cooling your freshly rebuilt engine. It's especially important to remove the radiator from a rear-wheel-drive vehicle because it's in the direct line of fire when you're separating the engine from the transmission.

Before removing the radiator, you need to remove the cooling fan. This procedure varies depending on the type of fan your engine uses. Mechanical fans are secured by four bolts that are screwed into the front of the water pump. To ease access to the fan, remove the plastic shroud surrounding it. Many shrouds are of a two-piece design; the upper and lower halves are bolted to the radiator or radiator support and are held together by a screw on each side near the midpoint of the radiator. Take care not to bend any radiator fins while removing the fan. Electric fans are bolted to supports on or around the radiator. Disconnect the wiring harness that leads to the fan before removing the fan mounting bolts.



You may need to use a screwdriver to break the bond between the radiator hoses and the nipples.

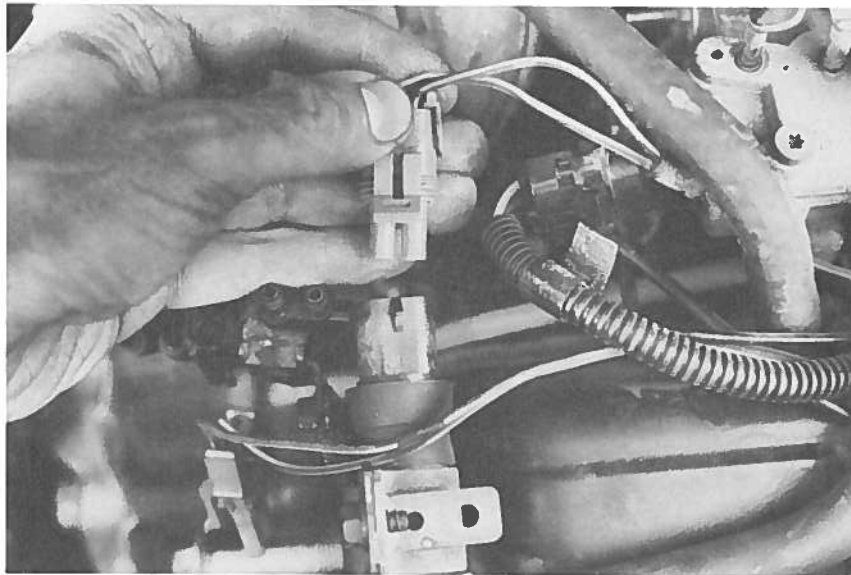
To remove the radiator, cut the factory clamps on the upper and lower radiator hoses, then rotate the hoses back and forth on the radiator nipples while pulling them off. If necessary, use a screwdriver between the hose and nipple to break the bond between them. Three or four bolts are usually used to hold the radiator to the top of the core support. The bottom of the radiator usually slips into U-shaped rubber biscuits at either side of the radiator.

Electrical System

Before you begin removing components and accessories, you'll need to disconnect the wiring that leads to them. As you do this, you'll find several electrical connectors under the hood, known as Metri-Pak connectors, which use an accordion-pleated silicone rubber boot. These connectors are designed to keep dirt and moisture out of the connection because any type of corrosion on the electrical terminals can cause an incorrect signal to be sent to the ECM. Since the ECM "adjusts" the carburetor duty cycle, fuel injection and ignition timing, and many emission control system functions based on information from these sensors, incorrect data from them can cause the ECM to make incorrect changes to these systems, thus affecting the performance and driveability of your vehicle. Consequently, take extra care when removing and installing these connectors. Make sure that you don't lose the boots and keep all solvents and moisture away from the connectors and their corresponding terminals.

Even the oil from your skin can create corrosion, so only make a visual inspection of the terminals, *don't* touch them with your fingers. If the terminals should need to be cleaned for some reason, clean them with circuit board cleaner (available at electronics stores) before reconnecting them.

As you're removing the connectors, don't be fooled by some of the latches on them. For example, one connector on a wiring harness that leads to an automatic transmission appears to latch at its back, but really latches on its bottom. So if you can't remove an electrical connector, be sure to check for a latch that you haven't disengaged. The latches can be positioned on the top, sides, or bottom of the connector.



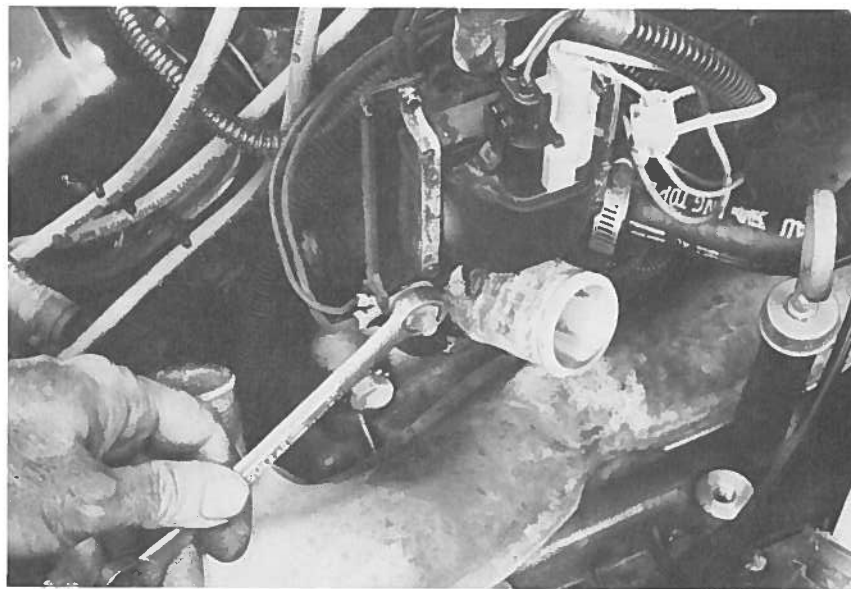
The pleated silicone boot is the tip-off that this is a Metri-Pak connector. Besides dirt and oil, the oil from your fingers can cause the terminals in these

connectors to corrode, so don't touch them. Most vehicles use these connectors.

On most vehicles, the ground wires for the ECM are secured to the thermostat housing, cylinder head, or transmission bell housing. Black wires with white tracers are usually used as ECM grounds and are often joined together in a ring terminal. On

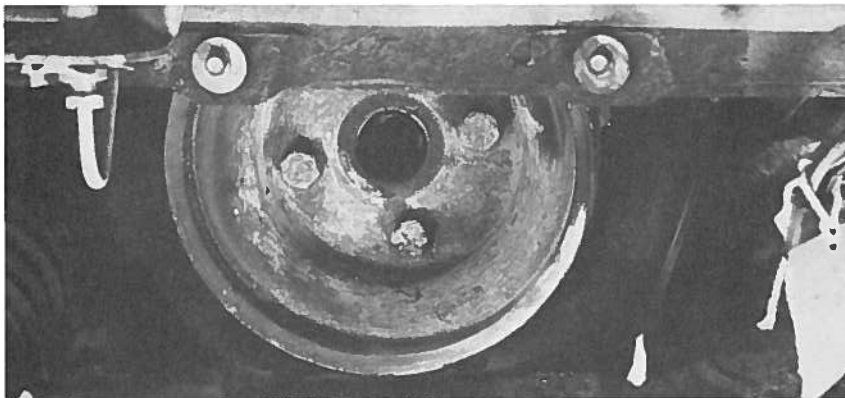
the thermostat housing, this ring terminal fits over a stud. Some vehicles even use two grounds, so pay attention!

And as you disconnect the wires from a particular wiring harness, lay the harness in an out-of-the-way



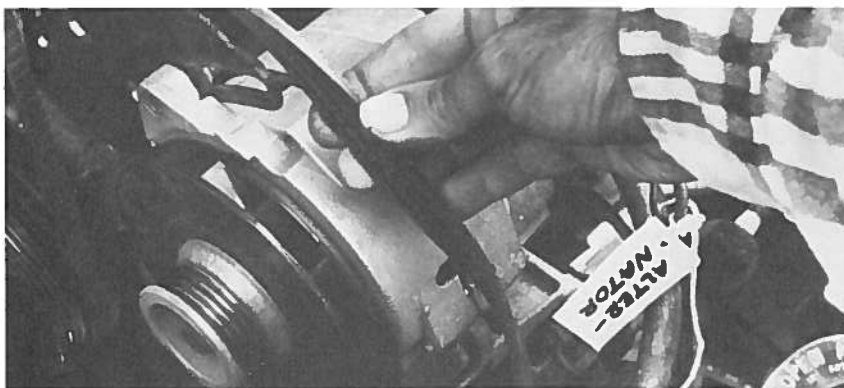
The two ground wires for this car's ECM attach to the stud for the thermostat housing. One of the wires is a backup should the other wire fail. Also, note the quick connector on the tach lead

from the ignition coil (small, light gray connector above the hose). Never tap into the sensitive Computer Command Control (C3) system, or you may trigger a host of driveability problems.



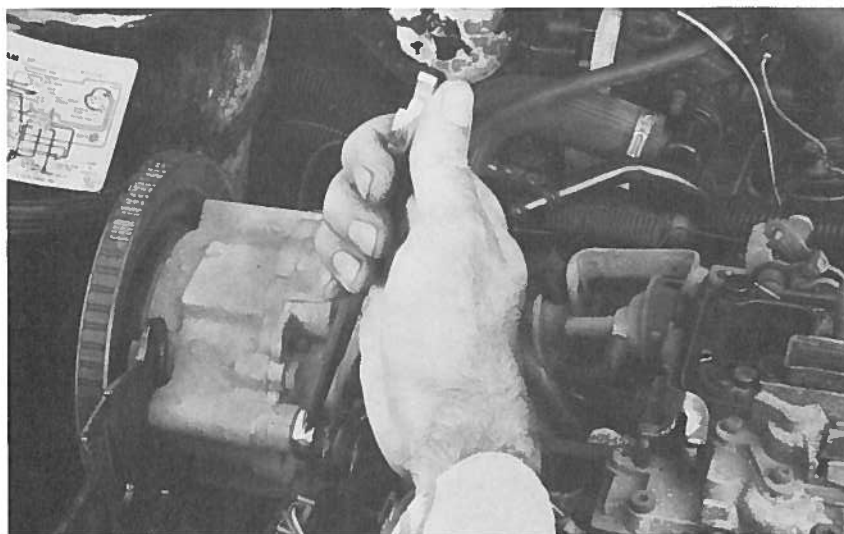
Loosen the crankshaft pulley bolts before you remove the accessory drive

belts, as the belts help keep the pulley from turning.



Disconnect the wiring from all the components before removing them. As you remove the drive belts from the acces-

sories, note their condition. If they're cracked or frayed, replace them.



Some bolts, like this one for the AIR pump, are accessible from only one side. When you're using a wrench, always pull on it, never push it. That way when the bolt breaks loose—or if you

slip—you won't smash or cut your hand. Note the vacuum hose routing diagram on the strut tower at the left of the picture.

place, such as the sides or rear of the engine compartment to keep them out of harm's way.

Accessories

Before you remove the engine, you'll need to remove such accessories as the alternator. However, before removing any accessories, you should first loosen the crankshaft pulley retaining bolts as they will be very difficult to remove without the belts in place to hold the pulleys.

Access to the pulley-retaining bolts on front-wheel-drive cars is provided by a cover in the right front wheel house. If the crankshaft turns as you try to loosen the bolts, give your ratchet handle a quick rap with a hammer. This will usually break the bolts loose. If this doesn't work, have your assistant hold the flywheel as outlined in the transmission section. Then you'll have to hit your ratchet sharply with a hammer to break the bolts loose or use an impact driver.

Accessories, such as the alternator, AIR pump, power steering pump, and air conditioning compressor are mounted to the engine with various types of brackets. The key thing to remember is that almost all of these accessories use at least one pivot bolt and one adjustment bolt to allow adjustment of belt tension.

On an accessory such as an air conditioning compressor, pivot and adjustment bolts are used on both the front and back sides of the compressor. So if the compressor won't pivot, chances are that one of its pivot or adjusting bolts isn't loosened. If it seems that a bolt won't loosen, check that the nut on the other end isn't turning. Some of the nuts aren't welded to the brackets, so if you try to loosen the bolt and all it does is rotate, you'll need to locate the nut and hold it with a socket or wrench.

Some brackets, such as those for the power steering pump, use shims to take up clearance between the bracket and the mounting surface. Keep these shims with the brackets for later use.

As the accessories are removed, try to keep them in sub-assemblies, with all the brackets, nuts, and bolts together and in their original positions, so that when it's time to put them back on the car, there won't be any guesswork.

Serpentine Accessory Drive Belt

If your engine uses just one belt to drive all the accessories, it's said to have a serpentine drive belt. To loosen this belt so that you can remove the accessories, insert a 1/2in breaker bar into the square hole in the end of the tensioner. While lifting the tensioner, slide the belt off the accessory pulleys. Then release the tensioner. Keep in mind that if your engine uses a serpentine drive belt, there are no positioning adjustments for the accessories. Only the tensioner can adjust belt tension.

Alternator

The alternator is usually one of the first accessories you'll have to remove. It usually has one pivot bolt at its bottom and an adjustment bolt on the top. By removing the adjustment bolt first, you can move the alternator. The pivot bolt's head is often at the back of the alternator and can be difficult to reach.

Crankshaft Pulley

There needs to be enough room in front-wheel-drive cars for the engine to move from side to side as you snake it out of the engine compartment. To give you as much room for this as possible, remove the pulley from the front of the crankshaft.

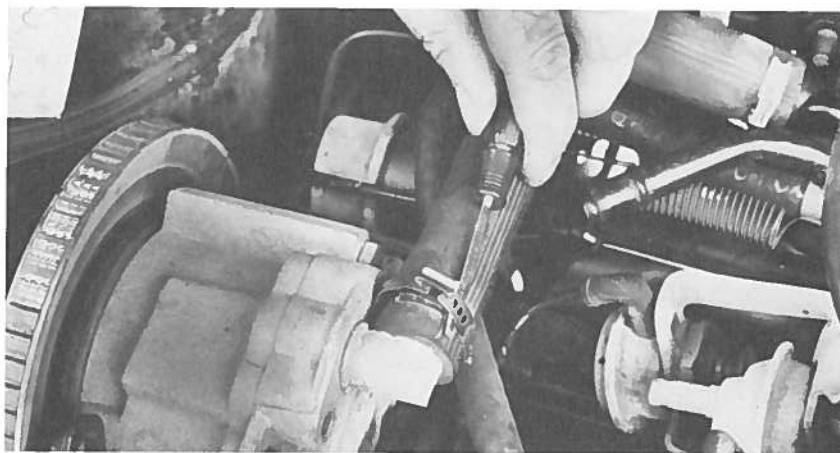
Power Steering Pump

Some power steering pumps have a pressure switch on the pressure line near the pump body. When this switch senses that pressure is above a predetermined level, the ECM cuts off the current feed to the clutch on the air conditioning compressor. This reduces the load on the engine when the steering wheel is at full lock, which helps prevent stalling. Carefully remove the wire leading to the pressure switch to prevent the harness from hanging up when you remove the engine.

The power steering pump is secured to the engine with two brackets: one at the front of the pump and one at the rear. Both brackets are slotted so that belt tension can be adjusted. The back of the pump has a stud that fits through the adjusting bracket and has a nut on its end.

Air Conditioning Compressor

There are two electrical connections at the air conditioning compressor. One is on the compressor clutch,

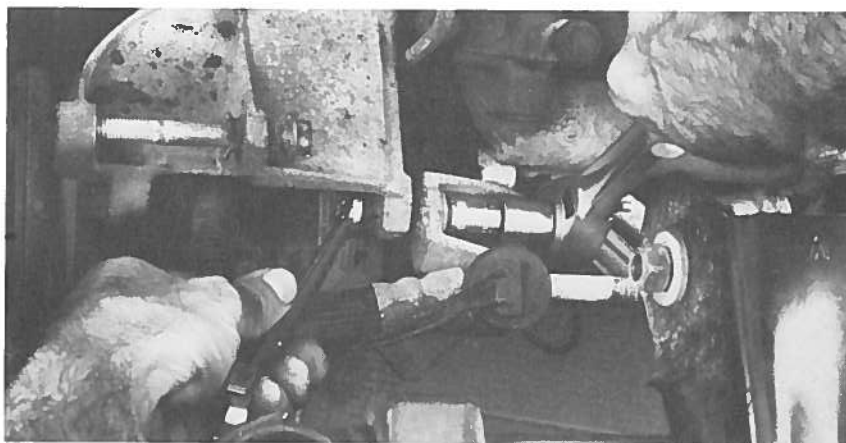


A band clamp like this can be released by sliding the tip of a small screwdriver underneath its end and prying up.



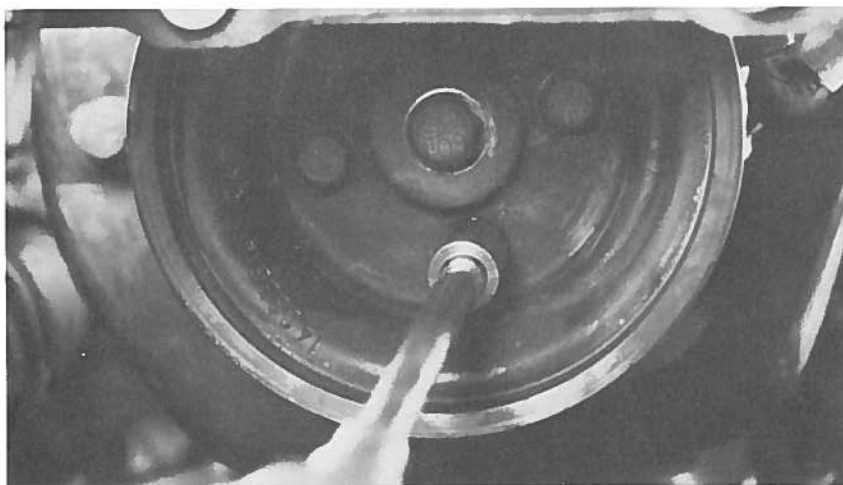
Serpentine belts are used on some 60deg V-6 engines to minimize the clutter and problems that come with multiple accessory drive belts. You can release the tension on the belt by slipping

the drive end of a breaker bar into the square hole in the tensioner and lifting up. The tensioner is at the bottom center of this photo.



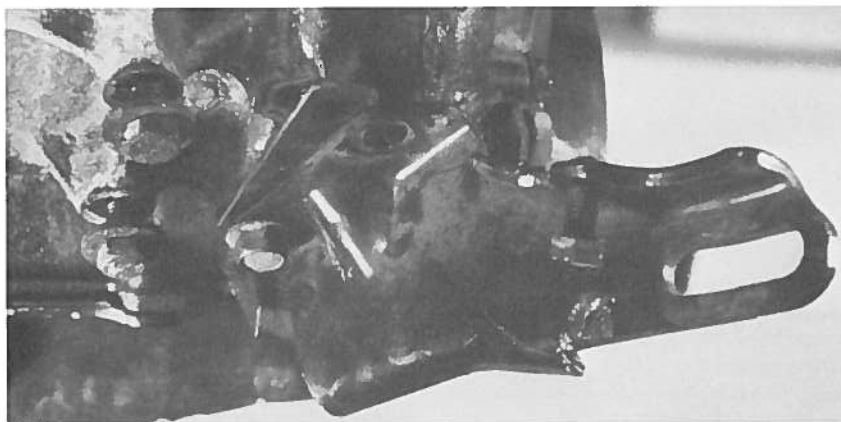
A number of bolts, such as the alternator pivot bolt in the bracket on the left, are accessible only from the back of the accessories. In many instances, if you remove the adjustment bolt first, you

can rotate the accessory and access the pivot bolt more easily. The circular cap with the two wires is the connector for the air conditioning pressure switch.



Now's the time to remove the crankshaft pulley. To remove the bolt from the middle of the damper, you'll have to

prevent the flywheel (or flexplate) from moving.



As you remove the bracket for the power steering pump, take note of any shims that may be behind the bracket.

Secure them to the pump with wire for installation later.



Several wires are connected to the starter solenoid. Note their positions before removing them.

which is right behind the pulley. To remove it, grab the connector and rock it to-and-fro while pulling it off. The other connector is mounted to the back of the compressor, and must be carefully removed with a flat-bladed screwdriver to avoid breaking it. After the accessories are removed, their mounting brackets will be revealed. Be sure to note their positions, then remove them.

Starter

Several electrical wires are connected to the starter solenoid. The large-diameter red wire secured to the large-diameter stud on the solenoid is the positive cable from the battery. The smaller wires on top of it are accessory feed wires. A small-diameter purple wire is attached to a small terminal or stud below the large stud on the solenoid. After noting the positions of the wires (and tagging them if necessary), remove them.

The starter is mounted to the block with two bolts. To remove the starter mounting bolts, remove the plastic cover on the drive end of the starter. One of the mounting bolts is outboard of the starter, and the other is positioned between the starter and the oil pan.

As you remove the starter, you may find a steel shim or two between its mounting surface and the block. These shims are essential to the proper spacing of the drive gear on the starter with the flywheel or flexplate on the engine. Be sure to keep them in a safe place for installation later.

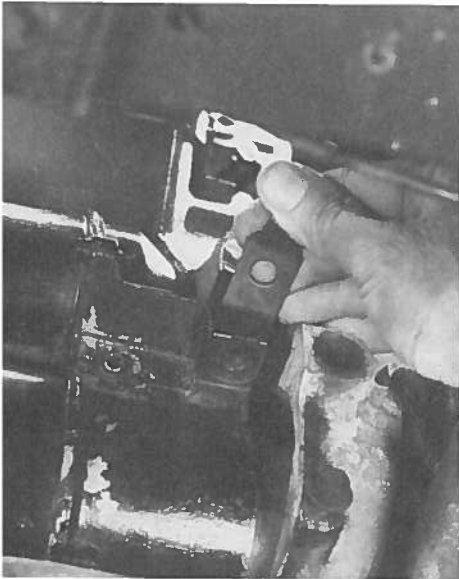
Fuel Pump and Lines

If your engine is outfitted with a carburetor, you'll need to remove the fuel lines and fuel pump. Typically, three fuel lines are connected to the fuel pump: the inlet line from the fuel tank, a return line to the fuel tank, and nestled between these two lines, a feed line to the carburetor.

To remove the fuel lines, remove any brackets that secure them to the engine or transmission. On some models, you'll also need to remove the fuel pump to access the engine mounts. However, on front-wheel-drive cars, it's easier to remove the pump when the engine is out of the car.

Heater Hoses

Before you get out your knife and slice through the heater hoses,



Shims are sometimes used to properly distance the starter drive gear from the flywheel. If you don't replace them, the starter can hang up on the flywheel when you try to start the engine, and this will destroy the starter.

you need to be aware that unlike the heater hoses of yore, many modern heater hoses are crimped on one end to a metal line with a ferrule. That's means modern heater hoses are expensive. Fortunately, the hoses use a clamp on their opposite ends that can be removed and the hose slipped off the nipple.

Since most heater hoses tend to bond themselves to their respective nipples like a 100-year-old oak tree is anchored into the ground, you'll have to work a flat-bladed screwdriver between the hose and nipple and work it around its diameter to break the bond. A shot of WD40 between them won't hurt either. When you think the bond is broken, twist the hose back and forth on the nipple while trying to pull it off.

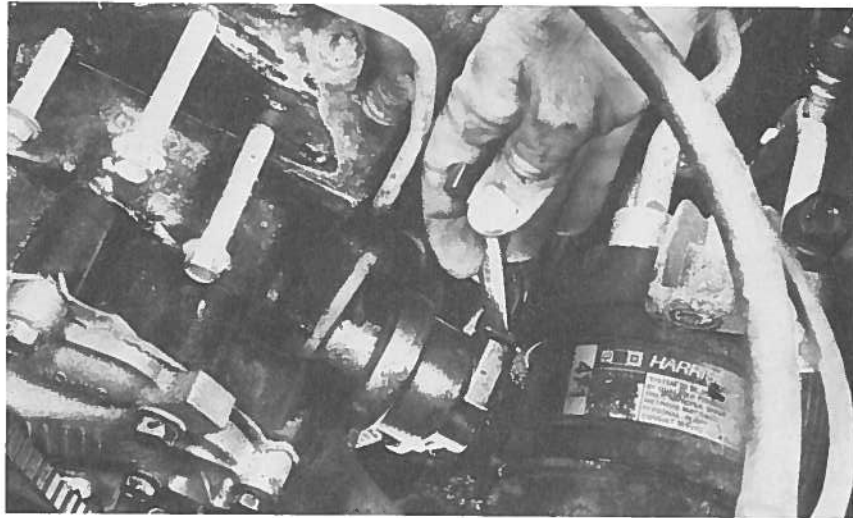
Vacuum Components

Power Brake Booster Hose

A vacuum supply hose runs from the power brake booster to the inlet manifold or carburetor. Disconnect this hose from the engine and plug it to keep out dirt and debris.

Other Hoses

A number of components are vacuum operated. Because they can vary greatly from vehicle to vehicle, you should tag and photograph all the



A flare-nut wrench is preferred for removing the lines from the fuel pump. You'll probably need to work from above and below the pump to access

the lines. Since working space is usually tight, you'll probably need to flip the wrench over to loosen all the fittings.

vacuum hoses. Otherwise, you'll never be able to assemble them correctly.

When removing vacuum hoses, rotate the fittings as you pull on them to prevent fracturing the hose. If a hose fractures, it can cause a vacuum leak that you may have trouble finding later.

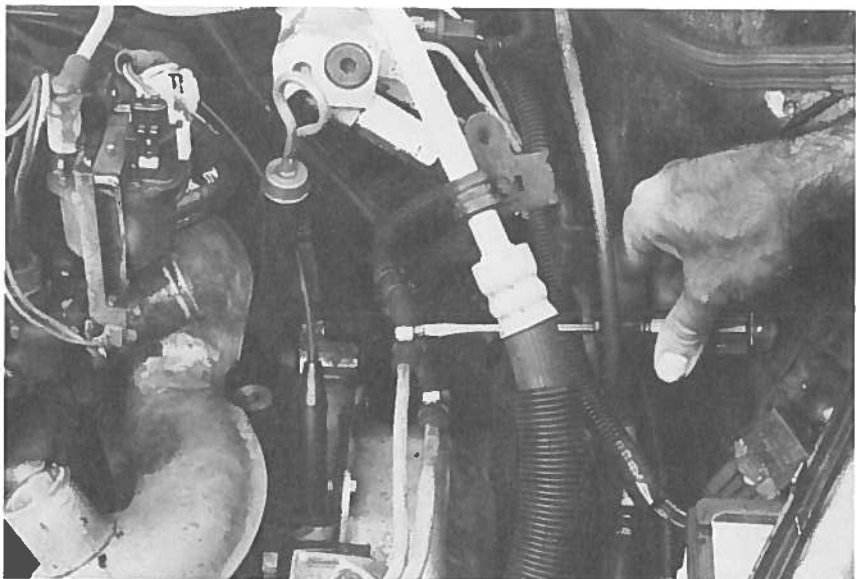
EGR Valve

Two types of EGR valves have been used on the 60deg V-6: vacuum

operated and electrically operated. Disconnect the vacuum line or wiring harness from the valve.

Exhaust System

Rear-wheel-drive and front-wheel-drive vehicles each have a unique exhaust system. On rear-wheel drive vehicles, a separate tube from each exhaust manifold meets in a Y-pipe, which in turn is connected to the exhaust system. Front-wheel-drive vehicles use a pipe to connect



To remove the fuel lines completely, disconnect them from the rubber supply lines. You'll also need to remove the re-

taining bracket, shown on the fuel lines and connected to the top of the transmission.



The hose clamps for the heater hoses in some vehicles are buried underneath the accessories. You'll need to remove

these clamps before you can remove the hoses.



Use of a flare-nut wrench will reduce the possibility of rounding off the nuts on the AIR manifold. Although you can remove the manifold when the engine is

in the car, on front-wheel-drive cars it's easier to remove it when the engine is out.



On front-wheel drive cars, loosening the bolts that secure the front exhaust manifold will allow you to remove the crossover pipe. When the front exhaust

manifold is out of the way, slip the crossover pipe off the studs of the rear exhaust manifold. Then snake the pipe out.

the front exhaust manifold to the rear exhaust manifold. Another flange on the rear manifold is attached to the exhaust pipe.

No matter which exhaust system you're working on, spray the manifold studs with a penetrant, such as WD-40 or GM Heat Valve Lubricant. Give the penetrant a few minutes to work.

To remove the nuts from the studs, use a six-point deep-well socket connected to a 1/2in drive ratchet with an extension bar. Don't use a twelve-point socket, because these nuts tend to rust to the studs and you'll probably round off the nuts.

If the nuts won't budge, you may have to use an impact driver or heat to remove them.

Caution: If you have to use heat, be extremely careful to keep it away from fuel lines and anything else that's flammable.

The exhaust manifolds on front-wheel-drive vehicles are connected to each other with a crossover tube that runs over the transmission's top. Only the rear exhaust manifold is connected to the exhaust system.

You'll have to crawl under the vehicle to disconnect the exhaust system from the rear manifold. Make sure that it's properly supported with jackstands and that the wheels on the ground are blocked to prevent rolling.

Disconnect the exhaust system from the rear manifold using a six-point socket connected to a 1/2in drive ratchet with an extension bar. Make sure the springs under the nuts don't hit you when you remove the nuts.

You'll need penetrating oil and a flare-nut wrench to remove the AIR tubes from the top of the exhaust manifolds. First give the nuts on the tubes a good shot of penetrating oil where they enter the exhaust manifolds as well as where the AIR tubes run through them. These nuts are notorious for sticking to the tubes. If they do that and you try to remove the nuts, you will twist the tube, collapsing it. This renders the AIR manifold worthless.

On front-wheel-drive cars, you'll have to remove the cross-over pipe from between the exhaust manifolds to remove the transmission bell housing bolts. To do this, use a six-point socket to remove the nuts from the manifold studs. Then loosen the bolts that retain the front exhaust manifold to the head, so you can slide the manifold on the bolts. This will allow you

to slip the crossover pipe out from between the manifolds.

Transmission

Several items can be bolted to the back of the transmission bell housing, including the ground wire from the engine to the body and brackets and clips that retain wiring harnesses. Photos or drawings of these components mounted on the transmission bell housing, as well as the back of the engine and front of the block, will be helpful during installation.

Some of the bell housing bolts may have a stud connected to their heads. This stud is used for mounting such things as wiring harness clips and engine lifting brackets. Before you remove them, note their positions.

Automatic Transmissions

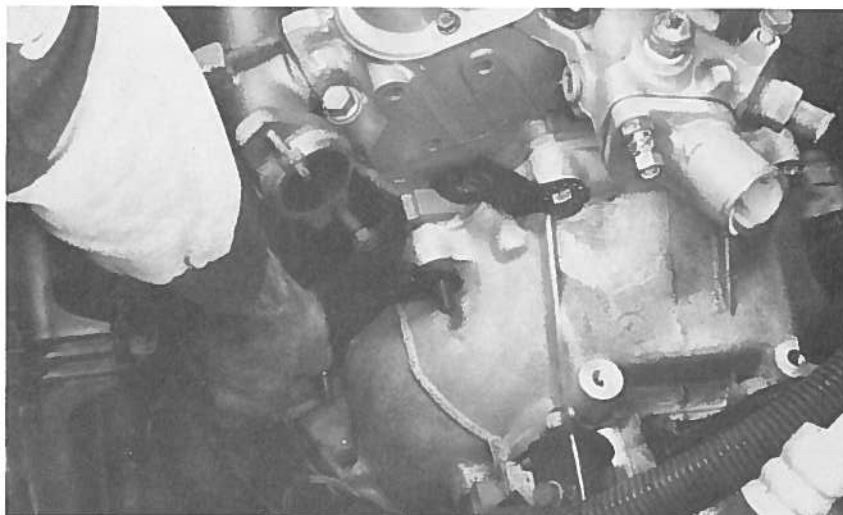
If your vehicle is equipped with an automatic transmission, it's best to remove the three bolts that secure the torque converter to the flexplate before you loosen the bell housing bolts.

Before you remove the three flexplate-to-torque converter retaining bolts, scribe a line on the flexplate and torque converter so that the two lines can be aligned with one another. These lines will indicate the original positioning of the torque converter to the flexplate and, if aligned during installation, will help keep the engine balanced.

You can see the torque converter retaining bolts by looking at the front of the flexplate where the starter was. They're positioned near the outside edge of the flexplate and are spaced 120deg apart.

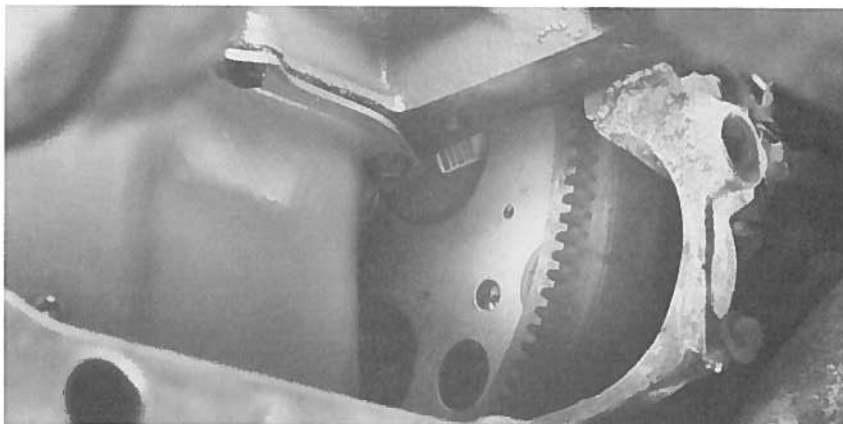
If you don't see any of the bolts, take a large, flat-bladed screwdriver and position it between two of the starter teeth on the flexplate. Then, using the inspection opening in the transmission case as a fulcrum point, rotate the flexplate, using the screwdriver as a lever. Rotate the flywheel as much as necessary to gain access to the bolts.

To loosen the bolts, you will have to hold the flywheel stationary. To do this, position the blade of a large screwdriver between two teeth on the flexplate. Prop the shaft of the screwdriver against the "window" in the transmission case. While pushing the screwdriver firmly between the starter teeth, hold the flywheel steady while you loosen and remove the first



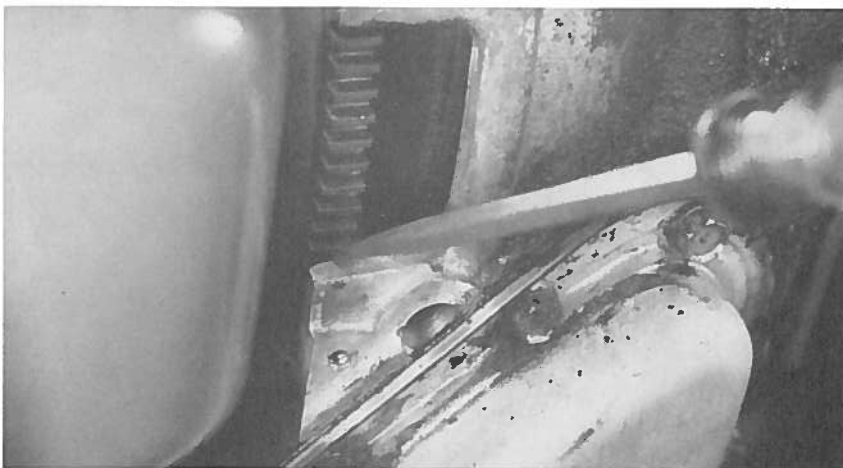
On this engine, two bell housing bolts have studs that mount a wiring bracket.

Be sure to note similar situations on your engine.

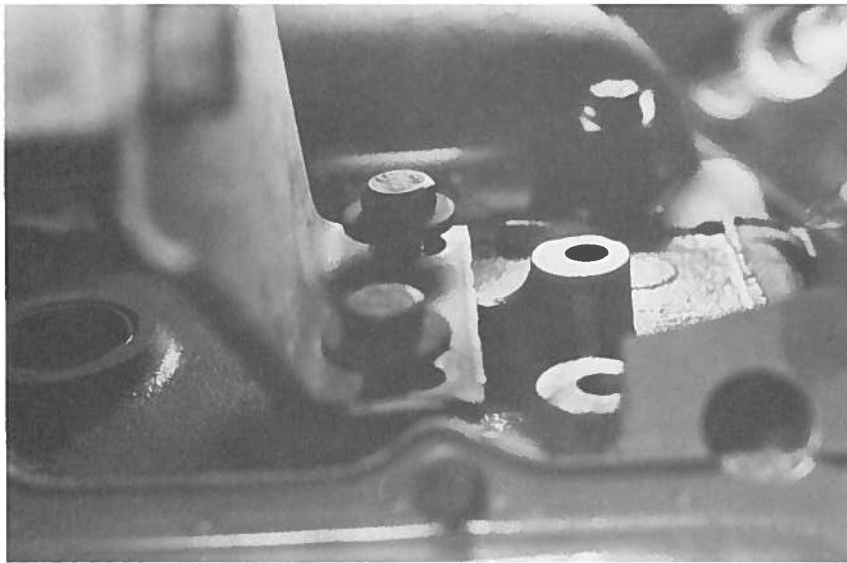


The torque converter mounting bolts are readily accessible near the starter mounting pad on the block. One of the

mounting bolts has already been removed.



You can rotate the flexplate by levering it around with a screwdriver.



In this view, you're looking up at the back of the block from underneath the car. The two bolts that are loosened se-

cure the bracket from the transmission to the block.

retaining bolt. Rotate the flywheel with the screwdriver to access the other retaining bolts. You may need your assistant to hold the flywheel while you loosen particularly stubborn bolts.

Manual Transmissions

If your vehicle is equipped with a manual transmission and rear-wheel-drive, you can usually separate the engine from the transmission without too much trouble. Front-

wheel-drive vehicles take a little more work, however. Due to the lack of working space between the engine and the right-hand frame rail, you'll need to loosen or remove the transmission mounting bolts so that you can angle the transmission far enough to separate the engine from it.

Bell Housing Bolts

All of the bell housing bolts except one are screwed through the bell housing into the engine block. The ex-

ception is a bolt that runs through the flange on the engine block and the transmission case. This bolt has a nut on its end; you will need an 18mm socket, two ratchet wrench universal joints, and extension bars to loosen and remove it. Feed the socket between the transmission and oil pan to ensure that the socket is squarely on the bolt head. This is important, as you'll need a significant amount of torque to break the bolt loose; and be sure to hold the nut with a wrench to prevent it from spinning.

Also, keep in mind that some front-wheel-drive cars use a bracket to secure the end of the transmission to the engine. This bracket is on the back of the engine, above the right-hand axle shaft, and is secured to the engine with two bolts. Remove these bolts.

After you've removed the bell housing bolts and disconnected the torque converter or removed the inspection cover underneath the transmission, connect the lifting chain to the engine. This helps prevent the engine from falling once the engine is separated from the transmission.

Motor Mounts

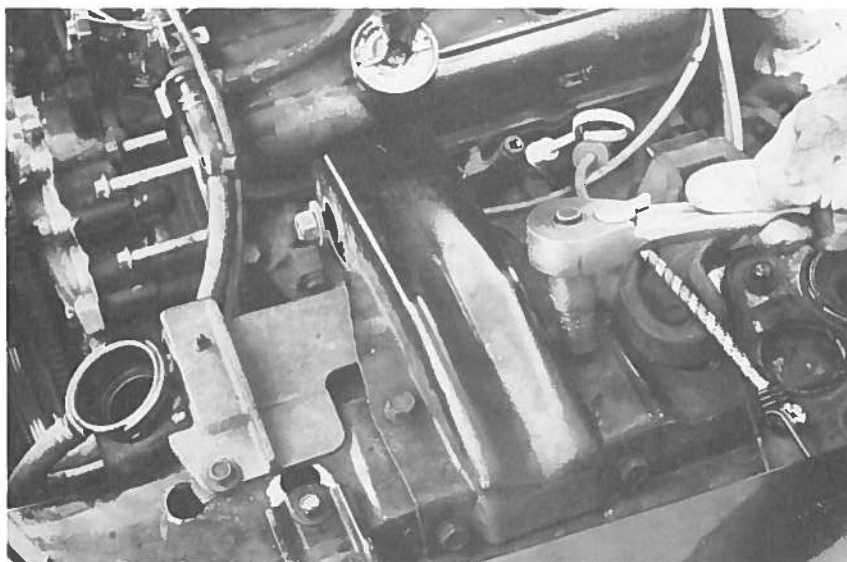
The motor mounts used on the 60deg V-6 are secured to the engine and the chassis with three bolts. On front-wheel-drive vehicles, one of these bolts on the front-most mount is actually a stud that is screwed into the block. This stud does double duty, securing both the engine mount and a flange on the engine oil dipstick tube. You'll have to bend the tabs on the dipstick tube flange to gain access to the hex on the stud so you can remove the stud.

Rear-wheel-drive vehicles use a long bolt that passes through both halves of each motor mount. After noting the orientation of these bolts, loosen and remove the nuts, but don't pull the bolts out until after you've connected the engine to the hoist and taken the load off the bolts.

Hood

Now it's time to consider whether you'll have to remove the hood. On many front-wheel-drive cars, the hood can be pushed back to a vertical position without damaging it. If this is the case with your vehicle, secure the hood in this position with some heavy rope and leave it at that.

However, if the hood on your vehicle won't open to the vertical, you'll



Front-wheel-drive vehicles use a locating strut at the top of the engine to help

keep the engine in position. The strut is secured to the radiator core support.

need to remove it. Before you remove any bolts, use a crayon or china marker to mark the underside of the hood so that you know where the front and side of each hinge was. Lay an old blanket across the lower edge of the windshield and trailing top edge of the fenders to prevent damaging them when the hood is removed.

Get at least two friends to help hold the hood while you remove the hinge bolts. Remove only the bolts that secure the hinges to the hood; otherwise you'll have a tough time aligning the hood later.

Connecting the Hoist

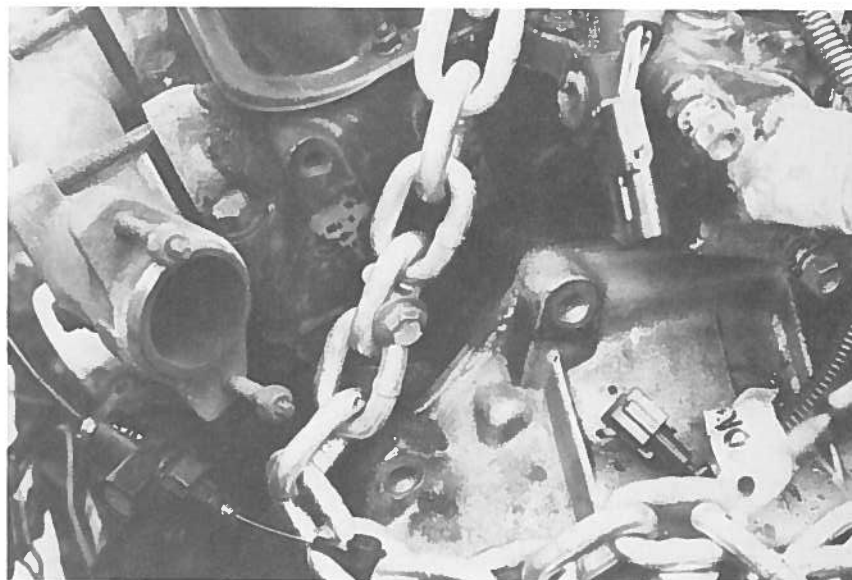
The next step is deciding where on the engine to attach the lift chain. Most engines have factory-installed eyelets, which were used to hoist the engine into the vehicle at the factory. You can use these same eyelets to remove and install the engine.

If your engine doesn't have eyelets, you'll need to secure a lift chain to some sturdy bolts on the engine, such as those used to mount the accessory brackets on the ends of the cylinder heads. It's important that one end of the chain be positioned at the front of the engine, toward one side, and that the other end be fastened at the rear of the engine, on the opposite side. This helps to stabilize the engine during removal and installation, and makes it safer to move around on the engine hoist.

Run the bolts (with heavy, large-diameter washers underneath the heads) through the links on the chain. This practically eliminates the chances of the chain slipping off the engine. Remember to use bolts that are long enough to screw into mounting holes completely, so that the threads of the bolts have enough material to pull against.

How you position the lifting chain on the hoist is determined by whether you're working on a front or rear-wheel-drive vehicle. If it's a rear-wheel-drive, secure the chain to the hoist so that you'll lift on the chain three to five links forward from the engine's center. This will cause the engine to tip downward at the rear during removal, allowing it to clear the radiator or core support as you remove the engine.

The procedure is different for front-wheel-drive cars. Since the right-hand frame rail in the engine compartment is so close to the front end of the engine, if you tilt the engine



If your engine doesn't have lifting eyelets, you can attach the lift chain to the cylinder heads. Use strong bolts and

screw them into the threaded holes in the ends of the heads.

much past horizontal, it will run into the frame rail. The tip here is to position the hoist hook in the center of the engine, and then pull the engine to the right side of the vehicle to free it from the transmission.

To create a loop in the lift chain for the hoist to hold, use a large bolt with thick washers on either end. Slip the bolt, with a washer under its head, through one of the links on the chain. Then select another link, six or seven links away, and thread the bolt through it. Slide the other washer over the end of the bolt, then screw the nut on securely. Now take this loop and place it over the hook on the hoist boom. To keep the chain from shifting, position the hook securely between two of the links. Now raise the boom to take most of the slack out of the chain. Leave a little slack so that it will be easier to separate the engine from the transmission.

At this point, you will need some assistance. Separating the engine from the transmission and removing the engine can be difficult and unsafe without extra eyes and hands to help guide you. Your assistants can watch for lines that you may have forgotten to detach or warn you that the engine is about to tear through the radiator.

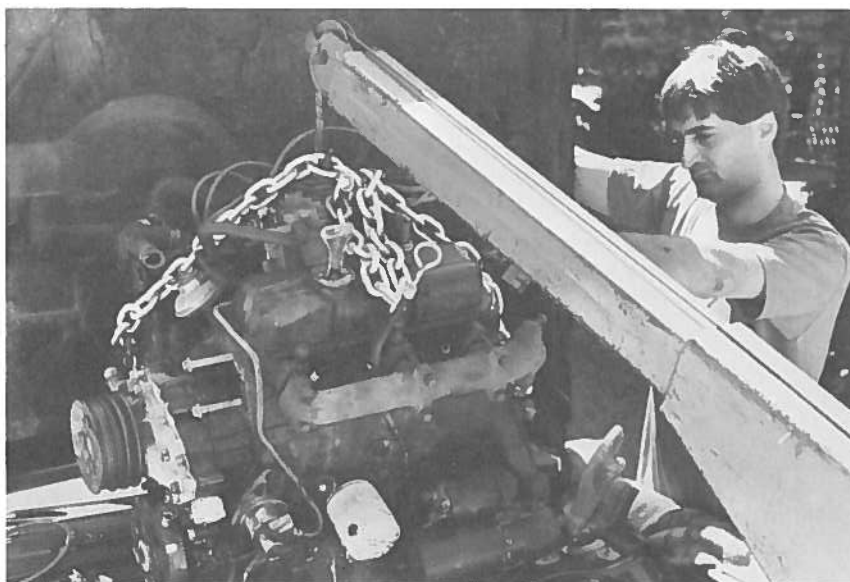
With your assistants on hand, you can separate the engine from the transmission. Do this by pulling on the hoist until a gap opens between the engine and bell housing. Then

slide a large, flat-bladed screwdriver into this gap, and lever the engine away from the transmission. When you've opened a large enough gap, complete the separation by inserting a pry bar and pulling—but first make sure your body is completely clear of the engine, transmission, and anything else that could injure you.

With the engine free of the transmission, station your assistants on either side of the car while you slowly raise the engine. Have them watch for wires or hoses that may still be attached to the engine, as well as any potential obstacle that the engine may catch on while you're lifting it. Work slowly to avoid accidents of any type. If you're not sure why the engine isn't moving, or has stopped moving, or is tilting to one side, stop and find out why.

Raise the engine far enough to clear the front of the vehicle, then slowly pull the hoist away from the car. When the engine is clear of the vehicle by a couple of feet or so, lower the engine to the ground. The next step is to remove any extraneous hardware from the back of the block so that you can bolt the head from the engine stand to it.

If an automatic transmission rides behind your engine, remove the bolts that hold the flexplate to the back of the crankshaft. You'll probably need to have an assistant hold the flexplate in position to do this. If your



After connecting the lift chain to the hoist, you can disconnect the motor mounts. With that done, you're ready to raise the engine. It's always better to have an assistant guide the engine and

watch for trouble as you raise the engine. If this assistant is a friend, and the friend allows you to tear apart his engine to write a book, so much the better. Thanks, Bob!

engine is mated to a manual transmission, mark an alignment position on the pressure plate and flywheel so that you can install the pressure plate with the same orientation. Next remove the pressure plate and clutch disc. Complete the job by having your assistant hold the flywheel as described above while you loosen the fly-

wheel bolts. As you remove the last bolt, make sure you have a good grip on the flywheel so it doesn't drop on you.

When the back of the block is clear, bolt the head from the engine stand to it. With washers under the heads of the bolts, run the bolts through the engine stand head into

the bell housing bolt holes in the back of the block. If any gap exists between the "fingers" of the head and the back of the block when the bolts are tightened, you'll have to put washers on the bolts to take up the gap(s).-

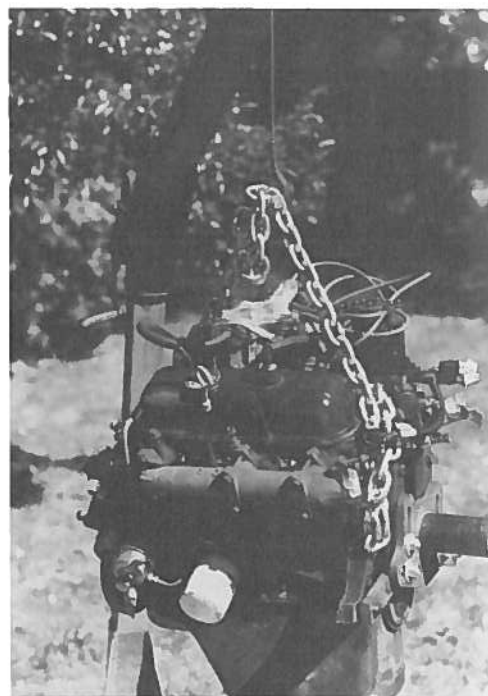
With the head securely attached to the engine, raise the engine far enough to slide the stand onto the head. Then tighten the pivot bolt on the stand to prevent the engine from rotating. At this point, you can lower the hoist and remove the chain-attaching bolts and chain.

After removing the engine, it's a good idea to clean it one more time. This helps reduce the amount of dirt and grime that will get into the engine as you disassemble it, and will actually save you time as compared to washing the exterior of all the pieces separately. Just make sure you've plugged all the openings in whatever components remain with duct tape or similar material to keep out soap, water, and grime.

After the engine dries, wheel it into your shop for the rebuild of its lifetime.



Use a bolt for a fulcrum and slide the tip of a pry bar between the teeth on the flexplate to keep it from rotating.



When the engine is out of the vehicle, bolt the head of the engine stand to it. Before tightening the bolts, shift the head so that it's centered on the block. This will help prevent the engine from inadvertently spinning when you get it on the stand.